

Claims

What is claimed is:

1. A coupler comprising:
 - a) a substrate having a plurality of layers;
 - b) a resistor formed on one of the layers;
 - c) a capacitor formed between two of the layers;
 - d) a ground plane formed on one of the layers;
 - e) a transformer attached to the substrate and electrically connected to the resistor and capacitor; and
 - f) a plurality of vias extending between the layers for providing electrical connections between the resistor, capacitor, ground plane and transformer.
2. The coupler according to claim 1 wherein the substrate is formed from layers of low temperature co-fired ceramic.
3. The coupler according to claim 1 wherein the transformer has a binocular core and a plurality of windings.
4. The coupler according to claim 3 wherein the transformer is attached to the substrate

5. The coupler according to claim 4 wherein a plurality of terminals are located on an upper layer.
6. The coupler according to claim 5 wherein the windings are electrically connected to the terminals by a plurality of welds.
7. The coupler according to claim 1 wherein the substrate is connected to a printed circuit board by a reflowed solder paste attached to at least one terminal on a bottom layer.
8. The coupler according to claim 1 wherein the capacitor has one electrode formed on one layer and a ground plane formed on another layer.
9. A coupler for providing coupling between an input port and a coupled port, the coupler having an output port and a terminated port, the coupler comprising:
 - a) a multi-layered low temperature co-fired ceramic substrate, the substrate having a top surface and a bottom surface;
 - b) a plurality of first terminals located on the top surface and a plurality of second terminals located on the bottom surface;
 - c) a transformer attached to the upper surface and electrically connected to the first terminals; and

d) a plurality of vias extending through the substrate for providing an electrical connection between the first terminals and the second terminals.

10. The coupler according to claim 9 wherein a resistor is formed on the top surface and is electrically connected between the transformer and a ground.

11. The coupler according to claim 10 wherein a capacitor is formed on the substrate and is electrically connected between the transformer and a ground.

12. The coupler according to claim 11 wherein a ground plane is formed on the substrate and is electrically connected between the transformer and a ground.

13. The coupler according to claim 11 wherein the transformer has a binocular core and a plurality of windings.

14. The coupler according to claim 12 wherein the transformer is attached to the substrate using an epoxy.

15. The coupler according to claim 14 wherein the windings are electrically connected to the first terminals by a plurality of welds.

16. The coupler according to claim 9 wherein the substrate is connected to a printed circuit board by a reflowed solder paste attached to the second terminals on the bottom surface.

17. The coupler according to claim 11 wherein the capacitor is formed by an electrode and a ground plane having a layer of the low temperature co-fired ceramic therebetween, the electrode and the ground plane each connected to a via.

18. A method of manufacturing a coupler comprising the steps of:

- a) providing a plurality of layers of low temperature co-fired ceramic;
- b) punching a plurality of holes in the low temperature co-fired ceramic layers;
- c) filling the holes with a conductive material to form a plurality of vias;
- d) screening a plurality of circuit features onto the layers;
- e) stacking the layers;
- f) firing the stacked layers in an oven to form a unitary substrate; and
- g) attaching a transformer to the substrate.

19. The method according to claim 18 wherein the circuit features are chosen from the group consisting of:

- a) resistors;
- b) capacitors;

- c) circuit lines;
- d) ground planes;
- e) vias;
- f) terminals; and
- g) resistor overglaze.

20. The method according to claim 18 wherein the transformer has a plurality of wire windings, the wire windings being welded to the terminals.

21. The method according to claim 18 wherein the transformer is attached to the substrate using an adhesive.

22. The method according to claim 18 wherein the transformer has a binocular core, the windings wound around the core so as to form an input port, a coupled port, an output port and a terminated port.

23. The method according to claim 18 wherein the substrate is attached to a printed circuit board, further comprising the steps of:

- a) screening a solder paste onto a bottom surface terminal;
- b) placing the substrate onto the printed circuit board; and
- c) reflowing the solder paste such that the substrate is attached to the printed circuit board.

24. A coupler comprising:

- a) an input port, a coupled port, an output port and a terminated port;
- b) a resistor connected to the terminated port;
- c) a capacitor connected to the terminated port;
- d) a low temperature co-fired ceramic substrate, the resistor and capacitor being formed on the substrate; and
- e) a transformer attached to the substrate and electrically connected to the ports.

25. The coupler according to claim 24 wherein a plurality of vias extend through the substrate for providing an electrical connection between the transformer and the resistor, the capacitor and the ports.

26. The coupler according to claim 25 wherein the substrate has a plurality of layers.

27. The coupler according to claim 26 wherein the resistor is formed on a first layer.

28. The coupler according to claim 26 wherein the capacitor is formed on a second layer.

29. The coupler according to claim 26 wherein a ground plane is formed on a third layer.

30. The coupler according to claim 27 wherein the transformer is electrically attached to a plurality of upper terminals on the first layer.

31. The coupler according to claim 29 wherein a plurality of bottom terminals are formed on the third layer.

32. The coupler according to claim 31 wherein the bottom terminals are connected to a printed circuit board.

33. The coupler according to claim 31 wherein the transformer has a binocular core and a plurality of windings.

34. The coupler according to claim 27 wherein a resistor overglaze is located over the resistor to protect the resistor.

35. The coupler according to claim 34 wherein an epoxy is located between the resistor overglaze and the transformer, the epoxy mechanically retaining the transformer to the first layer.